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COLLEGE STATION, BRAZOS COUNTY, TEXAS

BULLETIN NO. 516 NOVEMBER, 1935

DIVISION OF RANGE ANIMAL HUSBANDRY

EFFECT OF AGE, SEX, AND FERTILITY OF ANGORA GOATS ON THE QUALITY AND QUANTITY OF MOHAIR

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
T. O. WALTON, President

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The age of the animal has a very great influence on the weight of fleece, and on the quality (diameter) of fiber, with less influence on the length of staple, the amount of kemp, and the face, neck, and belly covering. The body weight is also responsive to age. The males produced heavier and coarser fleeces with slightly shorter staple than the females.

Pregnancy and lactation were found to have a marked lowering effect on weight of fleece and length of staple. The better developed animals were the ones represented in the fertile group at the younger ages. This obscured any possible reduction of weight of animal due to pregnancy. No direct effect on diameter of fiber was found due to pregnancy.

Maturity in females considered from the body weight standpoint for goats produced under range conditions, is not reached until the animals are 8 years old. Maximum diameter of fiber is also reached at 8 years, but maximum fleece weight is reached at three years. Maximum staple length is produced the first year. The most mohair per pound of body weight is produced at two years of age. Using this relationship, it is shown that the most efficient production is at two years, followed by a rapid decline with age.

To facilitate the study of records, a system of factors for correcting weight of fleece, length of staple, weight of animal, and diameter of fiber, for age, sex, and fertility, is given so that they can be compared on a uniform basis.

These findings are based on records of registered Angora goats raised at the Ranch Experiment Station in the Edwards Plateau region of Texas.

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EFFECT OF AGE, SEX, AND FERTILITY OF ANGORA GOATS ON THE QUALITY AND QUANTITY OF MOHAIR

By J. M. Jones, Chief, Division Range Animal Husbandry; B. L. Warwick, Animal Husbandman; and W. H. Dameron, Superintendent Substation No. 14; and S. P. Davis, Wool Specialist

Although the mohair industry in America is of comparatively recent origin, goat raising is, according to Biblical scriptures, one of the most ancient industries of civilization. The goat has served to provide both food and raiment for mankind through the ages.

The first importation of Angora goats to America was from Turkey in 1849 by Dr. James B. Davis of Columbia, South Carolina. Since that time, several importations have come from Turkey and South Africa, the latest from the latter country having been brought to Texas in 1925 by E. Cawood.

This industry in the United States has undergone rapid expansion. The number of Angora goats increased from 329,300 in 1900, as estimated by Black(1), to 3,937,000 in 1933(10). In 1934(10) the number was reduced to 3,359,000 head, which yielded 12,409,000 pounds of unscoured mohair, as compared with 15,895,000 pounds produced in 1933.

The Angora goat has played an important role in the Edwards Plateau area of Southwestern Texas, in which region approximately 85 percent of the Nation's goats are produced. The Angora goat was early found to thrive on the abundance of browse in that area, and by 1932 their numbers had increased to the full capacity of the ranges on most ranches.

For the benefit of the reader who may not be conversant with the Angora goat, the following brief description is included. A more complete description is given by Willingmyre, et al(11). Angora females raised under Texas range conditions and ranging from 2 years upwards weigh between 60 and 100 pounds. The Angora buck of corresponding age is considerably heavier, usually ranging from 100 to 150 pounds.

In the improved types, the head is well carried. The eye is bright and alert, the muzzle broad with mouth normal (i. e., when closed the edges of the incisors should fit snugly against the gum of the upper jaw without any protrusion of the teeth beyond the surface of the gum.) The ears should be pendent and between 6 and 8 inches in length. The horns should be greyish in color. In the males the horn has an inward spiral twist, at the same time inclining backward and outward; in the females, the horn rises upward and backward.

The topline, including rump, should be straight; however, the rump is usually inclined to droop somewhat. The legs are usually short and the chest should be broad, with well sprung ribs to assure a strong constitution.

The young, well-bred goat is characterized by its coat of mohair of distinctive lustrous spiral or flat locks, which adorn the body proper. The mohair fleece corresponds to the wool covering of the sheep; however, as a general rule the mohair fibers are of a greater thickness in diameter than the wool fibers of fine-wool breeds of sheep. The mohair fleece usually includes a sprinkling of coarse, brittle fibers, generally recognized as kemp. Highly improved strains of Angora goats produce a proportionately smaller amount of kemp as compared with the unimproved grades.

Concerning the importance of the grading and classification of mohair by the grower, the following is quoted from a letter received by Hayes(6) from the President of the Tingue Manufacturing Company, Seymour, Connecticut, written under date of March 24, 1882, which in part reads as follows: "In answer to your inquiries as to a market for mohair, we will only speak for ourselves, and would say, there is, in our judgment, no limit to be assigned to the consumption of mohair by manufacturers of various kinds; provided the breeders and growers will keep always in mind the fact that the standard in the raw fiber must always be the product of thoroughbred animals . . . . It is also essential that the shepherd or commission-men sort and grade the mohair, as is done by the Asiatic and African producers; then manufacturers like ourselves will know what we buy, and prices will be governed by the quality of the material. The sending into the market of good, indifferent, and positively useless material in the same bale compels us to make our purchases very largely abroad, that we may obtain the fiber we can rely upon. And here we do not hesitate to say that the goods we have made from the best quality of American-grown mohair are better and more salable than those made from raw materials we have imported . . . ."

Mohair of the various qualities possesses certain desired characteristics which tend to adapt each respective grade for manufacture into a particular type of material. The finer quality fleeces, as for example first fleeces produced under normal conditions by Angora kids, enter into the manufacture of the softest and most delicate of mohair fabrics.

Aside from the kid grades of mohair which, on account of their superior quality, command a higher price on the market than grades produced by mature Angora goats, there is as a general rule no differentiation in the prices offered. One of the most urgent needs in the mohair industry today, it appears to the writers, is a closer understanding between the producers, dealers, and manufacturers. As is quite generally recognized, the Texas mohair clip is usually sold on an average rather than a strictly quality basis. The result has been that many of the producers have sacrificed quality in order to increase yield or quantity.

STATEMENT OF PROBLEM

In 1914, leaders in the Texas mohair industry called to the attention of the Texas Agricultural Experiment Station the urgent need of im-

mediate research into problems facing the Angora goat industry. As a result of the widespread interest in the problems confronting the Angora goat breeders of Texas, a branch Experiment Station, now generally known throughout the Southwest as the Ranch Experiment Station, was established in Sutton and Edwards counties midway between Sonora and Rocksprings by legislative enactment in 1915. Studies on Angora goats at the Ranch Experiment Station during 1917-1923 showed that there was a high correlation between the fleece weights of the same animal from season to season (9).

The findings presented in this bulletin are the first of a series of publications covering extensive investigations since 1922. This bulletin relates more specifically to (1) effect of age of animal on weight of fleece, quality as indicated by diameter of fiber, length of staple, weight of animal, relative amount of kemp, and covering of mohair on face, neck, and belly; (2) effect of sex on diameter of fiber, weight of fleece, and weight of animal; and (3) effect of pregnancy and lactation on diameter of fiber, weight of fleece, and weight of animal.

PLAN OF PROCEDURE

The animals from which the records were taken and used in this study included all of the registered Angora goats maintained at the Ranch Experiment Station for the period 1923 to 1933 inclusive.

In addition to the routine records pertinent to a registered breeding flock, detailed records were taken just before the first fall and each spring shearing. At this time a small sample of mohair was clipped from the shoulder, side, and thigh respectively, for diameter measurements in the laboratory at College Station.

In order to study diameter changes in detail, samples of mohair have been taken from designated points on the shoulder, side, and thigh of each goat for measuring. After washing in carbon tetrachloride, to completely remove all foreign matter including grease and dirt, 100 fibers from each sample were measured by means of a machinist's micrometer caliper graduated to measure to one-ten-thousandths of an inch, according to the method of Hill(2)(4)(7). The 100 measurements were averaged to one additional decimal place. For convenience in handling the figures, the number of ten-thousandths have been used as a whole number and the extra decimal used as tenths. As an example, an average of .00092 has in this bulletin been handled as 9.2 ten-thousandths.

At the time the samples of mohair were taken, the length of staple was measured on the living animal and the length recorded in inches to one-fourth inch. The figure used is the average of the three lengths recorded for shoulder, side, and thigh. That for the first fall age represents the growth during the spring and summer of the animal's life. The other figures used represent the length of staple at the spring shearing rather than 12 months' growth. The first kid fleeces represent

slightly more than 6 months' growth, and the yearling fleece measurements were taken before any of the animals were bred.

At this time the relative covering by mohair of head and neck was recorded. The degree is recorded as covered, medium covered, or bare, and the arbitrary figures 1, 2, or 3 respectively were used to represent the classification. Covering of mohair on the belly was recorded in the same way with the following designations: 1 = covered (densely covered), 2 = medium (medium dense), 3 = bare or very light. Each animal was examined at this time and a note made as to whether it was free from kemp, had a trace of kemp, was kempy, or was very kempy. According to our terminology, "very kempy" is not to be taken literally, since our flock is composed of pure-bred animals carrying probably as small a percentage of kemp as any flock in America. These classes were given the values 0, 1, 2, and 3 respectively.

The animals were shorn twice a year as is the usual practice in that region. The fall shearing date was about the first of September, while that of the spring shearing was about March 30. Fleece weights were recorded in pounds and tenths. About one-third of the fleeces, which were representative of the various groups, were shipped to College Station for scouring in the Station Wool and Mohair Scouring Plant. In order to obtain the clean (scoured) weight of the individual fleece, each was scoured separately. The scouring equipment used is of the small commercial type consisting of an automatic feed and a train of three bowls equipped with squeeze rolls. Wire baskets were used as containers to avoid loss of portions of the fleece during the process. The agents used were neutral olive oil soap, soda ash, and water. The clean weights used are not figured on a bone dry basis but as cold weights which include the normal regain under average atmospheric conditions after drying.

The animals were weighed at about 30 days after shearing each spring.

RESULTS OF THIS INVESTIGATION

Weight of Fleece

The average fleece weight of unscoured mohair at each age for each sex is shown in Table 1 and Figure 1. Each twelve months' production of mohair per animal is shown as the combined weights of the fall and spring shearings of the respective ages. Accordingly, in this study the 12 months' fleece weight corresponds as nearly as possible to the age year rather than to the calendar year. The combined twelve months' unscoured fleece weights for the respective ages in this table are compiled from animals that were each sheared two times during the period, and are not the combination of averages. It is observed that there is a marked increase in the weight of fleece of the Angora doe up to and including three years of age, after which there is a steady decline in both weight and quality. Study of the differences by ages

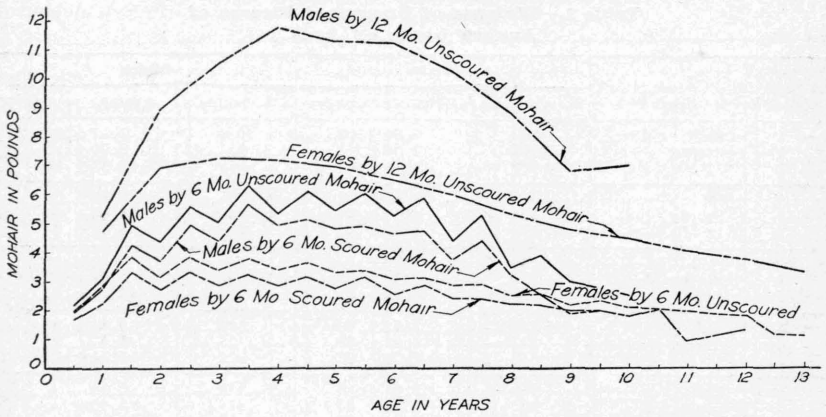

Fig. 1. Relation of age, sex, and season to weight of fleece.

shows that the trend is definite and that the fleece weights for goats handled strictly under range conditions decline with age after the third year.

The averages of each age (12 months) from one to 12 years inclusive for the females have been studied to determine whether the differences are significant. Of the 66 possible age comparisons there are only six which do not differ enough to be significant statistically. Two of these are comparisons of the first with the nine and ten year old production respectively. Another is of the two with the five year old. The other five are comparisons of three with four, four with five, nine with ten, ten with eleven, and eleven with twelve. Thus it is seen that the only comparisons which are not definitely significant are either some of the adjacent ages or similar points on the opposite sides of the maximum.

Table 1 also shows that, with the exception of the first, the fall shorn fleeces average heavier than either the preceding or succeeding spring fleeces. This is true in spite of the fact that the actual interval between the dates of spring and fall shearing is slightly shorter than that between the fall and the succeeding spring shearings. These relationships also hold for the clean mohair averages which are shown in Table 2 and Figure 1. Only relatively few males were kept in the flock after the first year of age; therefore the age relationship for this sex must be only suggestive.

It will be seen from the above that there is no period in the life of the Angora goat when weight of mohair produced reaches stability. This fact is of importance in considering the fleece weights of any group of goats, whether from the standpoint of breeding and selection or for the study of the relationship of fleece weight to other factors.

Table 1. Weights of Unscoured Fleeces of Angora Goats by Ages

Age Year	Season	Females		Males	
		No. Animals	Average pounds	No. Animals	Average pounds
1	Fall	590	1.94 ± .02	633	2.17 ± .02
1	Spring	549	2.80 ± .02	551	3.06 ± .02
1	12 Mo.	549	4.74 ± .03	549	5.21 ± .03
2	Fall	471	3.84 ± .02	105	4.96 ± .09
2	Spring	496	3.15 ± .02	128	4.42 ± .08
2	12 Mo.	473	6.92 ± .04	108	8.98 ± .14
3	Fall	389	3.84 ± .03	49	5.57 ± .18
3	Spring	391	3.43 ± .03	59	5.06 ± .15
3	12 Mo.	387	7.26 ± .05	49	10.55 ± .43
4	Fall	330	3.78 ± .03	22	6.34 ± .26
4	Spring	337	3.41 ± .03	25	5.41 ± .22
4	12 Mo.	332	7.20 ± .05	22	11.73 ± .83
5	Fall	259	3.61 ± .04	14	6.13
5	Spring	263	3.32 ± .03	14	5.48
5	12 Mo.	259	6.96 ± .06	15	11.35
6	Fall	203	3.40 ± .04	8	6.02
6	Spring	199	3.09 ± .04	8	5.28
6	12 Mo.	199	6.49 ± .06	8	11.30
7	Fall	156	3.17 ± .04	6	5.83
7	Spring	152	2.82 ± .04	6	4.43
7	12 Mo.	153	5.99 ± .07	6	10.27
8	Fall	134	2.84 ± .04	4	5.38
8	Spring	133	2.50 ± .04	4	3.48
8	12 Mo.	133	5.34 ± .07	4	8.85
9	Fall	97	2.57 ± .05	4	3.85
9	Spring	94	2.22 ± .05	4	2.95
9	12 Mo.	94	4.82 ± .09	4	6.80
10	Fall	73	2.33 ± .04	2	2.75
10	Spring	73	2.13 ± .07	1	2.50
10	12 Mo.	71	4.50 ± .10	1	7.00
11	Fall	48	2.06 ± .08	....	.....
11	Spring	48	1.98 ± .07	....	.....
11	12 Mo.	48	4.04 ± .14	....	.....
12	Fall	23	1.87 ± .08	....	.....
12	Spring	24	1.80 ± .10	....	.....
12	12 Mo.	22	3.72 ± .17	....	.....
13	Fall	3	1.60	....	.....
13	Spring	4	1.53	....	.....
13	12 Mo.	3	3.33	....	.....

Fineness of Fiber

The price difference between kid mohair and that from older goats is presumably based largely on the difference in fineness, or diameter, of the fiber, although luster, softness, curl or character of locks, length of staple, and relative freeness from kemp are highly important.

The averages for shoulder, side, and thigh mohair diameter measurements were computed separately for each age. The averages for all three regions at each age were also calculated. These averages are all given in Table 3 and shown graphically in Figure 2. These data include all females in the flock from 1923 to 1931 inclusive, and in addition all those that were eight years old and older for 1932 and 1933.

Table 2. Weights of Clean Fleeces of Angora Goats by Ages

Age Year	Season	Females				Males			
		No. of Animals	Av. Fleece Wt. lbs.		Average Shrinkage %	No. of Animals	Av. Fleece Wt. lbs.		Average Shrinkage %
			Unscoured	Clean			Unscoured	Clean	
1	Fall	222	1.92	1.68	12.69	173	2.11	1.85	12.72
1	Spring	269	2.81	2.33	17.06	161	3.16	2.71	13.84
2	Fall	206	3.85	3.35	12.63	68	5.14	4.29	17.01
2	Spring	312	3.17	2.67	15.44	63	4.43	3.70	16.15
3	Fall	181	3.88	3.37	12.66	30	6.18	4.98	19.18
3	Spring	242	3.37	2.87	14.66	33	5.24	4.42	15.35
4	Fall	96	3.74	3.24	12.89	15	6.90	5.61	17.69
4	Spring	173	3.36	2.86	14.57	19	5.71	4.98	12.31
5	Fall	74	3.65	3.22	12.21	10	6.29	5.12	19.48
5	Spring	125	3.23	2.77	14.08	14	5.78	4.87	14.16
6	Fall	52	3.60	3.18	11.55	4	5.66	4.90	13.17
6	Spring	97	2.96	2.57	12.96	7	5.31	4.65	10.77
7	Fall	45	3.15	2.85	9.32	5	5.65	4.74	17.56
7	Spring	74	2.73	2.40	11.81	6	4.44	3.70	15.38
8	Fall	27	2.71	2.41	10.77	4	5.46	4.42	18.02
8	Spring	67	2.52	2.21	12.10	4	3.58	3.21	8.97
9	Fall	42	2.46	2.21	10.33	....	....	....	....
9	Spring	43	2.17	1.93	10.80	2	2.08	1.88	9.03
10	Fall	27	2.19	1.96	10.50	1	2.20	2.00	9.09
10	Spring	41	2.06	1.77	12.91	....	....	....	....
11	Fall	8	2.40	2.08	12.72	....	....	....	....
11	Spring	20	1.72	1.46	15.61	....	....	....	....
12	Fall	....	....	....	....	....	....	....	....
12	Spring	5	2.12	1.81	14.46	....	....	....	....

These data show, for the females, that at six months of age the mohair is finest on the shoulder and coarsest on the thigh, but that the reverse of this is true at each succeeding age. The mohair from the thigh on either sex did not average as coarse as that from the shoulder at any age after 6 months. However, the differences are not very great at any age. Comparisons between (a) shoulder and side, (b) shoulder and thigh, and (c) side and thigh for the females have been made at each age and the differences compared with their probable errors. The differences are small and most of them are either clearly not significant or are not far from the line between significance and lack of significance. The differences between thigh and shoulder and between thigh and side on the 6 months old animal are significant, even though small. The differences between shoulder and side are clearly significant only at one year of age. Four of the differences between shoulder and thigh and one between side and thigh at the different ages (after 6 months) are significant. There is little if any preference between the quality of the mohair produced on the shoulder and side. Practical handling of the mohair generally reveals that the locks from the shoulder possess more curl or waviness than those from the side and thigh.

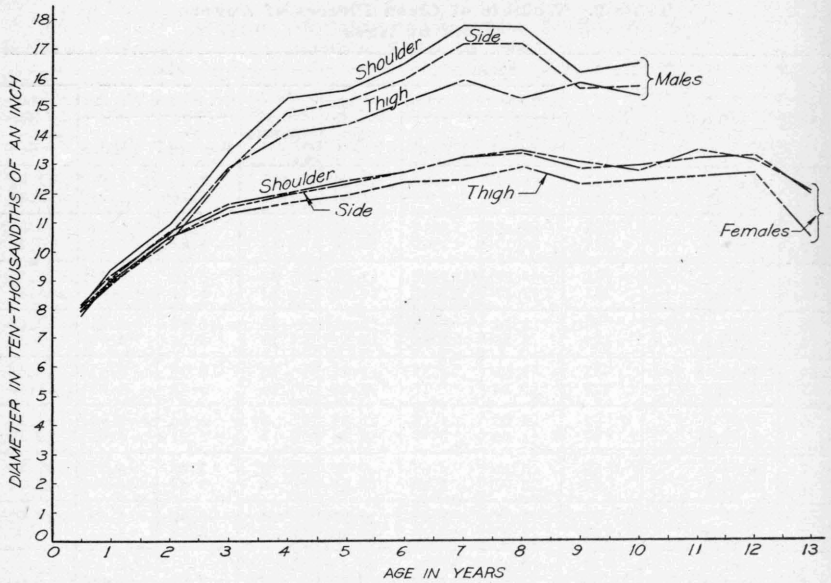

Fig. 2. Relation of age and sex to diameter of fiber.

Table 3 shows further that for the females at each age the fiber diameter for the respective region of the body increases up to eight years of age. At eight to thirteen years of age, the averages are close together but tend to decline slightly. Every possible comparison by ages for the shoulder, side, and thigh respectively has been studied. These show beyond doubt that the fiber diameter trend upward is definite and significant up to eight years of age for each region. At eight years, and older, there is only one significant diameter difference. For obvious reasons the numbers of animals are much smaller at the older ages, and although our figures do not show that this trend is significant, we are not prepared, with the limited data available for the older ages, to say that it could not be.

These results emphasize the fact that the diameter of the fiber continues to increase long past the age at which the weight of fleece reaches its maximum and corresponds more nearly to changes in body weight, which will be discussed later.

Length of Staple

The average staple length by ages is given in Table 4. It is shown that the first kid fleece has the longest staple of any of the ages. The staple length of the yearling spring fleece is appreciably shorter than that of the first kid fleece, but longer than that of any spring fleece at older ages. The two-year-old does have the shortest staple of any age

Table 3. Average Diameter of Fiber of Angora Goats by Ages Expressed in Ten-thousandths of an Inch

FEMALES

Age	Shoulder		Side		Thigh		Average	
	No. Animals	Average	No. Animals	Average	No. Animals	Average	No. Animals	Average
6 Mo.	387	7.81 ± .03	387	7.88 ± .03	387	8.05 ± .02	387	7.91 ± .05
1 Yr.	444	9.07 ± .04	443	8.81 ± .04	443	8.85 ± .04	444	8.91 ± .02
2 Yrs.	417	10.66 ± .04	417	10.48 ± .05	417	10.48 ± .04	417	10.54 ± .02
3 Yrs.	321	11.61 ± .06	320	11.53 ± .07	320	11.37 ± .06	321	11.51 ± .04
4 Yrs.	250	12.02 ± .07	250	11.97 ± .07	249	11.68 ± .06	250	11.89 ± .04
5 Yrs.	184	12.42 ± .09	184	12.39 ± .09	184	11.95 ± .09	184	12.25 ± .05
6 Yrs.	143	12.70 ± .09	143	12.70 ± .09	143	12.40 ± .09	143	12.60 ± .05
7 Yrs.	114	13.27 ± .12	113	13.27 ± .12	113	12.49 ± .11	114	13.01 ± .07
8 Yrs.	103	13.46 ± .09	103	13.35 ± .10	103	12.87 ± .09	103	13.23 ± .06
9 Yrs.	97	13.03 ± .13	96	12.78 ± .12	96	12.32 ± .12	97	12.71 ± .07
10 Yrs.	75	12.76 ± .13	75	12.95 ± .14	75	12.45 ± .14	75	12.72 ± .08
11 Yrs.	48	13.49 ± .21	48	13.19 ± .22	48	12.54 ± .22	48	13.07 ± .13
12 Yrs.	25	13.12 ± .26	25	13.21 ± .28	25	12.68 ± .33	25	13.01 ± .16
13 Yrs.	4	12.10	4	12.05	4	10.50	4	11.55

MALES

Age	Shoulder		Side		Thigh		Average	
	No. Animals	Average	No. Animals	Average	No. Animals	Average	No. Animals	Average
6 Mo.	305	8.05 ± .04	305	7.95 ± .04	305	8.07 ± .04	305	8.03 ± .02
1 Yr.	367	9.44 ± .05	366	8.93 ± .05	367	9.16 ± .05	366	9.17 ± .03
2 Yrs.	110	10.92 ± .12	110	10.44 ± .12	110	10.56 ± .12	110	10.64 ± .07
3 Yrs.	39	13.48 ± .25	37	12.78 ± .24	37	12.89 ± .26	37	13.06 ± .14
4 Yrs.	20	15.26 ± .36	20	14.68 ± .37	20	14.02 ± .31	20	14.66 ± .20
5 Yrs.	16	15.52	16	15.14	16	14.34	16	15.00
6 Yrs.	8	16.48	8	15.98	8	15.11	8	15.85
7 Yrs.	5	17.72	5	17.12	5	15.92	5	16.92
8 Yrs.	4	17.68	4	17.12	4	15.18	4	16.66
9 Yrs.	4	15.65	4	15.58	4	15.80	4	15.68
10 Yrs.	2	16.45	2	15.65	2	15.40	2	15.83
11 Yrs.	....	.....	....	.....	....	.....	....	.....
12 Yrs.	....	.....	....	.....	....	.....	....	.....
13 Yrs.	....	.....	....	.....	....	.....	....	.....

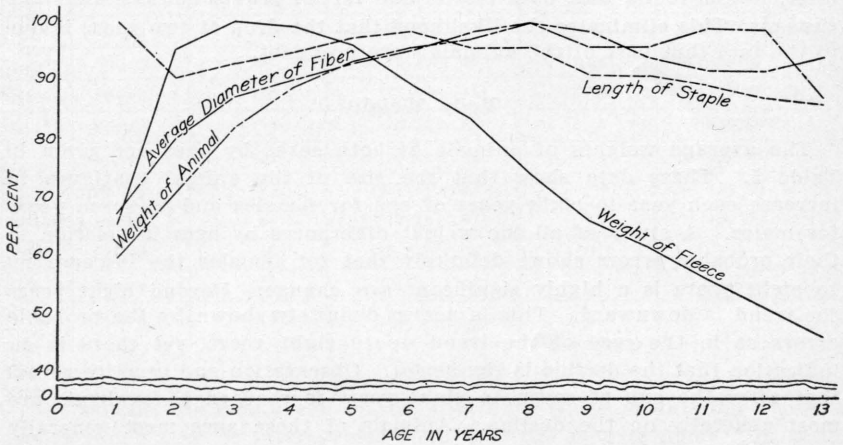

Fig. 3. Relation of relative fleece weight, staple length, diameter of fiber, and animal weight to age of maximum production.

until after ten years. However, the locks of the two-year-old does possess plenty of curl or character, whereas the mohair of older goats losses its characteristic curl. The averages gradually rise again after

Table 4. Length of Staple of Angora Goats by Ages

Age Year	Females		Males	
	No. Animals	Average inches	No. Animals	Average inches
1 Fall	548	6.21 ± .02	591	5.94 ± .02
1 Spring	562	6.00 ± .02	567	6.13 ± .16
2 Spring	498	5.42 ± .02	94	5.38 ± .07
3 Spring	394	5.57 ± .02	32	5.59 ± .12
4 Spring	337	5.67 ± .03	20	5.62 ± .10
5 Spring	261	5.84 ± .03	14	5.96
6 Spring	200	5.77 ± .03	8	6.00
7 Spring	155	5.73 ± .04	5	5.98
8 Spring	132	5.71 ± .05	4	6.20
9 Spring	97	5.44 ± .05	4	5.85
10 Spring	74	5.46 ± .06	1	5.40
11 Spring	46	5.35 ± .08	.....	.....
12 Spring	25	5.23 ± .09	.....	.....
13 Spring	4	5.17	....	.....

two years to a secondary maximum at five years, after which there is a gradual decline with age. Comparison of all possible age differences shows that the main trends are undoubtedly significant. In the study of the effect of pregnancy and lactation on staple length, to be discussed later, it was found that both sterile and fertile groups show similar age changes. This eliminates the likelihood that the drop at two years is due to the fact that part of the animals were pregnant.

Body Weight

The average weights of animals of both sexes by ages are given in Table 5. These data show that the size of the animal continues to increase each year to eight years of age for females and to seven years for males. A study of all the weight differences by ages in relation to their probable errors shows definitely that for females the increase up to eight years is a highly significant age change. Beyond eight years the trend is downward. This is not so definitely shown by the probable errors as in the case of the trend up to eight years, yet there is an indication that the decline is significant. Observation and practice reveal that after the age of seven to eight years is reached the animals are most generally on the decline. Animals of these ages most generally carry less flesh than do younger goats, and obviously lose some weight.

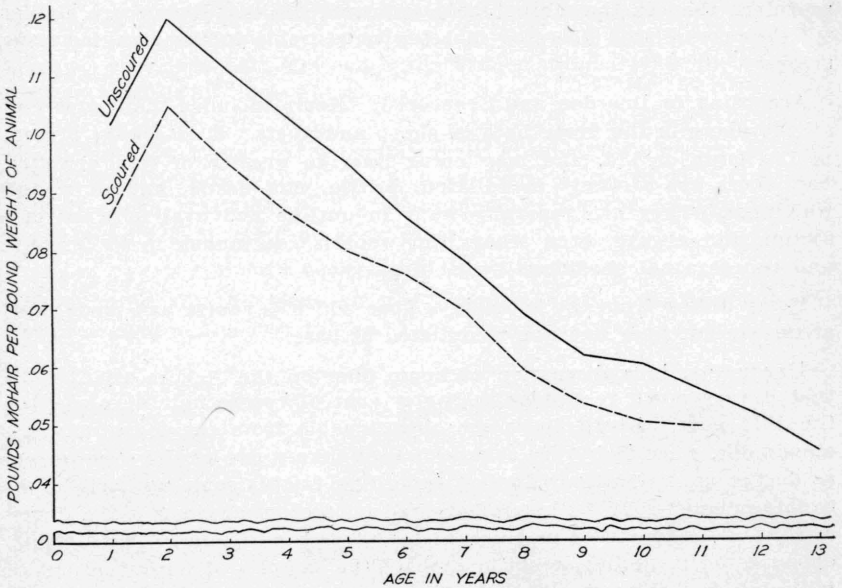

Fig. 4. Relation of age to pounds of mohair produced per pound of body weight.

Table 5. Weights of Animals by Ages

Age Year	Season	Female		Male	
		No. Animals	Average pounds	No. Animals	Average pounds
1	Fall	605	33.95 ± .22	639	37.46 ± .25
1	Spring	549	46.61 ± .25	509	60.55 ± .46
2	Spring	499	57.56 ± .29	132	80.73 ± 1.15
3	Spring	396	64.89 ± .30	59	99.85 ± 2.26
4	Spring	336	69.93 ± .37	25	122.12 ± 3.54
5	Spring	264	73.26 ± .45	14	139.07
6	Spring	192	75.49 ± .45	8	149.38
7	Spring	150	76.56 ± .53	5	149.80
8	Spring	124	78.94 ± .71	4	139.75
9	Spring	93	77.41 ± .92	4	134.50
10	Spring	66	74.45 ± .97	1	109.00
11	Spring	45	72.64 ± 1.04	...	.....
12	Spring	23	72.83 ± 1.63	...	.....
13	Spring	4	74.50	...	.....

Kemp

In mohair, the kemps are coarse, stiff, dull, white medullated fibers or hairs which may be interspersed with the true mohair fibers. In scrub or unimproved Angora goat flocks, the kemp type of fiber is much more

prevalent than in the more highly improved flocks. Kemps are similar to other medullated fibers[12] in being undesirable in the manufacturing process.

According to Duerden and Spencer[3], "Kemp includes the coarsest of all the fibers in the fleece both of sheep and goats. It is always present in the lamb or kid, and may occur later in greater or less quantity. The fibers are strongly medullated, brittle, non-elastic, and of a dull whiteness. They are generally wavy in outline and oval in transverse section and always, even where the wool is continuous in its growth, undergo seasonal shedding."

Kemp differs from the heterotype fiber which is coarse and medullated at the tip but finer and non-medullated at base.

Hardy [5], in a discussion of kemp fiber on the Angora goat, states that it very much resembles the outer coat of coarse hair developed on the wild goat. Kemp fibers are objectionable from the manufacturer's standpoint, since they very seldom if ever take a dye to the same extent as do the normal mohair fibers. According to this same authority, "the average diameter of the kemp measured microscopically was 0.052 whereas that of the improved mohair was only 0.046 millimeter. The difficulty encountered in finding kemp in each of the samples of improved mohair indicated that there was less of it than in the commercial hair."

Hirst and King, of the British Research Association for the Woolen and Worsted Industries[8], have stated that "kemp in mohair possesses the same objectionable features from the manufacturing standpoint as

Table 6. Relative Amount of Kemp by Ages*

Age Year	Females		Males	
	No. Animals	Average rating	No. Animals	Average rating
1 Fall 1 Spring	573 555	1.8 1.8	613 552	1.7 1.7
2 Spring	492	1.8	104	1.5
3 Spring	396	1.9	39	1.6
4 Spring	336	1.9	20	1.7
5 Spring	262	1.9	15	1.7
6 Spring	201	2.0	8	1.8
7 Spring	156	2.1	5	1.6
8 Spring	133	2.2	4	2.3
9 Spring	97	2.2	4	2.0
10 Spring	75	2.2	2	2.0
11 Spring	48	2.1	.....	.....
12 Spring	27	2.2	.....	.....
13 Spring	4	2.5	.....	.....

* 0=no kemp; 1=trace of kemp; 2=kempy; 3=very kempy.

kemp in wool. The characteristic whiteness and lack of strength, elasticity, and apparent dyeing affinity, are due to inclusion of air within a network of cells of honey-comb appearance which make up the inner core or medulla of such fibers . . . ."

Since kemp is detrimental to the commercial value of the mohair fleece, we have in our experimental flock, avoided very kempy animals.

The relative amounts of kemp have been averaged for each age. Table 6 shows that there is a general tendency for the Angora goats to produce more kemp as they grow older.

Mohair Covering of Head and Neck

Observations on the degree of covering of mohair on the face and neck were recorded at the first fall and each spring shearing. These observa-

Fig. 5. Heads of Angora females to show well covered, medium covered and bare heads and necks.

Table 7. Relative Amount of Mohair Covering on Head and Belly*

Age Year	Females				Males			
	Belly		Head		Belly		Head	
	No. Animals	Average	No. Animals	Average	No. Animals	Average	No. Animals	Average
1 Fall	593	1.28	596	1.70	645	1.25	646	1.61
1 Spring	553	1.07	576	1.90	566	1.24	577	2.12
2 Spring	479	1.09	509	1.84	109	1.04	110	1.87
3 Spring	382	1.11	399	1.90	34	1.06	39	1.72
4 Spring	314	1.08	340	1.62	17	1.00	20	1.95
5 Spring	262	1.11	266	1.96	13	1.08	15	1.67
6 Spring	183	1.14	201	2.07	7	1.14	8	2.12
7 Spring	143	1.19	156	1.86	4	1.00	5	1.80
8 Spring	115	1.17	132	2.02	4	1.00	4	1.25
9 Spring	97	1.33	97	1.77	4	1.25	4	1.25
10 Spring	75	1.35	75	1.79	2	2.00	2	1.00
11 Spring	48	1.37	48	1.73	.....	.....	.....	.....
12 Spring	28	1.29	28	1.46	.....	.....	.....	.....
13 Spring	4	1.25	4	1.50	.....	.....	.....	.....

* 1=densly covered; 2=medium covered; 3=very light covered.

tions were recorded as covered, medium, and bare. The averages of these ages are given in Table 7. These do not show much difference except that the older ages have very good averages. Selection has probably had much to do with retaining the better covered does to old age.

Mohair Covering of Belly

The averages are given in Table 7. They show that the belly did not appear to be quite so densely covered at the first shearing as it is at each later spring shearing until about the ninth year of age. The nine-

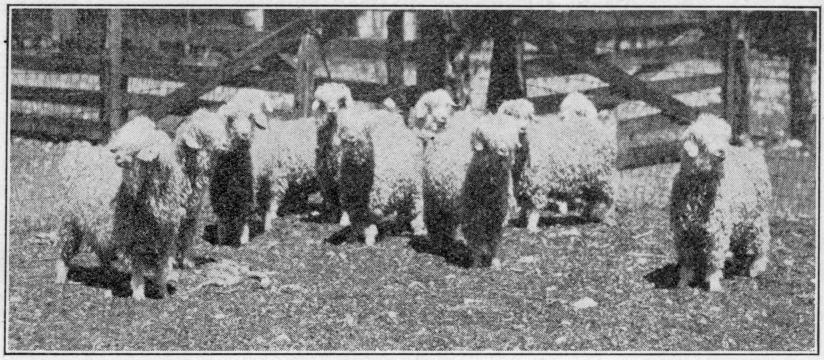

Fig. 6. A group of desirable yearling females in the Station flock.

year and older does tend to be slightly less densely covered than those of 1 to 8 years. This is true of the covering over the entire body.

Effect of Sex of Animal

Study of Tables 1 to 5 shows that fleece weight, animal weight, and diameter of fiber average greater at each age for the males than for the females. Staple length averages less for the males than for the females at the first kid fleece. At older ages the male averages are slightly greater at six of the ages and less at four. Because of the small numbers of males at ages after one year, we must exercise caution in interpreting the significance of the differences. However, it is interesting to note that at every age at which we can compare the averages statistically, the males have significantly heavier fleeces and body weight. At three of the five ages the diameter of fiber averages significantly greater for the males. The differences at the first fall and second spring fleeces are not statistically significant. Staple length difference is only significant at the first kid fleece. Kemp, belly covering, and face covering differences between the males and females are too small to be considered of much moment.

In order to evaluate the average percentage differences between males and females for unscoured fleece weight, clean fleece weight, diameter of fiber, staple length, and animal weight, the following procedure has been

Fig. 7. A group of stud bucks in the Station flock.

used in each case: All the data for both sexes were combined and the averages obtained at each age. The figure 100 was divided by each average to obtain the corresponding conversion factor. These conversion factors to the base 100 were then used to convert the averages for each age and sex into comparable figures. This was done by multiplying the particular average by the corresponding conversion factor. This converted average was then multiplied by the number of records from which it was obtained. All of these for the same sex were added together and divided by the total number of records for that sex. This gave a weighted, age-converted average which might be compared with 100 as the general average, or with the average obtained for the other sex. The percent greater which one of these averages was than that of the average for the other sex was obtained in the ordinary way. The

Table 8. Effect of Sex of Animal on Relative Mohair Production and on Relative Weight of Animal

	Weighted Averages Based on 100		Difference %
	Male	Female	
Weight of unscoured fleece	113.61	96.15	+18.16
Weight of clean fleece	121.87	94.55	+28.89
Diameter of fiber	103.06	98.98	+ 4.12
Length of staple	99.60	100.19	— .59
Weight of Animal	114.98	93.73	+22.67

results as seen in Table 8 show that the unscoured fleece weight averaged 18.16 percent more for the males than for the females, the clean weight

28.89 percent, the animal weight 22.67 percent, and the diameter of fiber 4.12 percent more. Staple length averaged .59 percent less for the males than for the females. However, these figures merely represent the

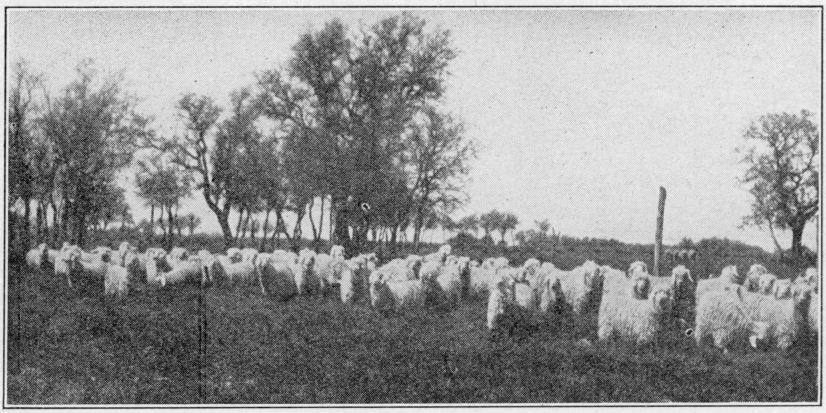

Fig. 8. Mature Angora females on the Ranch Experiment Station.

average after age has been taken into consideration. These figures are only of general interest rather than figures which can be used directly. Methods of converting the averages of the different ages and sexes to comparable figures for other uses are discussed in a later section of this paper.

Effect of Pregnancy and Lactation

The records of all does from 2 to 12 years of age inclusive during the years 1923 to 1932 inclusive have been used to study the effect of pregnancy and lactation. Table 9 gives the average unscoured fleece weights of the does grouped as sterile, kidded but young died, and raised. In addition, all fertile have been combined and all dry have been combined for comparison with sterile and raised respectively. This shows that the sterile does produced more at every spring shearing age than did the fertile group. The differences between the sterile and raised, the sterile and fertile, and the dry and raised groups have been studied in relation to their probable errors. The differences at the respective ages are significant at ages up to and including 5 years. At only two of the older ages are the differences statistically significant. We are inclined to attribute this to the small numbers rather than to a difference in effect with increasing age. In support of this assumption is the observation that at each age the average for the sterile group is greater than that of either the raised or the all fertile group. There is less than one chance in 100 that a group of seven differences would have the difference always in the same direction if due to chance only. In the comparison of the raised with the all dry group at the older ages, there

is one age, 6 years, at which the average of the raised group is greater than that of the dry group. While this difference is very small, the

Table 9. Effect of Pregnancy and Lactation on Weight of Fleece

Ages yrs.		Sterile goats		Goats kidded but young died		Goats kidded and raised kids		All Fertile goats		All Dry goats	
At Kidding Season	At Shearing	No. Animals	Average, lbs.	No. Animals	Average, lbs.	No. Animals	Average, lbs.	No. Animals	Average, lbs.	No. Animals	Average, lbs.
		Unscoured Fall Fleeces (preceeding the kidding season concerned)									
2	1½	219	3.64	14	3.68	184	4.04	198	4.02	233	3.65
3	2½	101	3.65	15	4.23	237	3.92	252	3.94	116	3.72
4	3½	62	3.66	6	4.10	222	3.82	228	3.83	68	3.70
5	4½	30	3.59	10	3.56	169	3.61	179	3.61	40	3.58
6	5½	28	3.21	8	3.12	136	3.47	144	3.45	36	3.19
7	6½	18	2.87	4	3.35	110	3.21	114	3.22	22	2.95
8	7½	19	2.92	6	2.95	92	2.86	98	2.86	25	2.93
9	8½	15	2.54	9	2.49	62	2.61	71	2.60	24	2.52
10	9½	15	2.27	8	2.26	46	2.38	54	2.36	23	2.27
11	10½	13	2.31	3	2.73	29	1.89	32	1.97	16	2.39
12	11½	8	1.95	3	2.07	8	2.06	11	2.06	11	1.98
		Unscoured Spring Fleeces									
2	2	227	3.37	17	2.97	194	3.03	211	3.03	244	3.34
3	3	102	3.83	14	3.31	239	3.30	253	3.30	116	3.77
4	4	63	3.72	6	3.62	229	3.40	235	3.41	69	3.71
5	5	31	3.82	9	3.52	173	3.28	182	3.30	40	3.75
6	6	26	3.23	8	2.60	135	3.12	143	3.09	34	3.09
7	7	18	3.05	4	2.32	109	2.82	113	2.80	22	2.92
8	8	19	2.68	6	2.18	91	2.46	97	2.44	25	2.56
9	9	15	2.58	9	1.71	62	2.15	71	2.09	24	2.25
10	10	16	2.53	7	2.30	46	1.95	53	2.00	23	2.46
11	11	13	2.48	3	1.97	29	1.78	32	1.80	16	2.39
12	12	7	2.27	3	1.73	11	1.56	14	1.60	10	2.11
		Unscoured Fall Fleeces (succeeding the kidding season concerned)									
2	2½	183	4.20	14	3.74	143	3.43	157	3.46	197	4.17
3	3½	77	4.34	12	3.38	176	3.46	188	3.46	89	4.21
4	4½	39	4.20	5	4.46	163	3.44	168	3.47	44	4.23
5	5½	23	3.93	8	3.44	123	3.31	131	3.32	31	3.80
6	6½	19	3.63	6	3.17	94	3.12	100	3.12	25	3.52
7	7½	14	3.52	3	2.87	83	2.76	86	2.76	17	3.41
8	8½	13	2.90	6	2.85	67	2.50	73	2.53	19	2.88
9	9½	13	2.50	7	2.30	49	2.30	56	2.30	20	2.43
10	10½	9	2.76	3	1.93	32	1.92	35	1.92	12	2.55
11	11½	6	2.42	.....	.....	14	1.59	14	1.59	6	2.42
12	12½	1	1.50	.....	.....	2	1.65	2	1.65	1	1.50

other differences are also consistently smaller than those of the comparisons discussed above. This indicates that combining the group which kidded but the young died with the fertile group rather than with the sterile group gives a more valid grouping for this purpose.

In order to compare all of the data of these groups, it is necessary to consider the effect of age and of the unequal number of records at the different ages. For this purpose the averages for all does as given in Table 1 have been used to compute conversion factors. In each case 100 has been divided by the particular average fleece weight for that age. These conversion factors to the base 100 are used to convert the averages in the different groups to comparable figures. After each average has been multiplied by its conversion factor, it is multiplied by the number of records represented by that average. These totals for each age of the group are added together, and divided by the total

number of records to get the converted average. These converted averages are related to 100 as the average of all records. The results are given in Table 11. These show that the sterile group averaged 12.82 per cent more unscoured mohair than was produced by the fertile group.

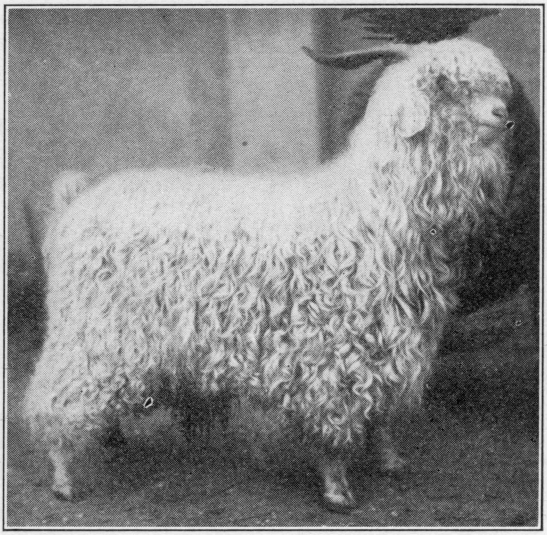

Fig. 9. One of the well covered stud bucks used in the Station flock.

About half of the fleeces were scoured and the records have been grouped according to whether the animals were sterile or fertile. The averages for each age are shown in Table 10. This shows that the clean spring fleeces of the sterile group averaged heavier than those of the fertile group at every age except one, when the difference was slight. Conversion factors to 100 were prepared from the averages of Table 2, and converted averages computed for the sterile and fertile groups. These as seen in Table 10 show that the sterile does averaged 7.43 per cent more clean mohair than did the fertile does. Much of the difference in fleece weight of the sterile and fertile groups is due to the effect of pregnancy. This is shown by the fact that the sterile group not only averaged more mohair than the raised and all fertile groups, but also averaged more than the group which kidded but the young were stillborn or died young. The age converted average for the sterile group is 16.88 per cent higher than that of the group which kidded but did not raise the young. However, most of the kids were born before shearing, so that suckling was bound to cause part of the effect.

In order to determine whether the animals which were sterile produced more or less mohair the preceding fall than did the fertile group, both unscoured and scoured records were grouped accordingly. These are shown in Tables 8 and 9. These show that with both unscoured and clean fleece weights at most ages the sterile averages less than the fertile group. This is especially marked at the first age (2 years). The differences of the unscoured averages at all of the ages have been studied in relation to their probable errors. The differences at 2 and 3 years of age are the only ones that are significant. Two years of age is the youngest that any of the does are permitted to produce young. At this age more are sterile than drop kids. Even at three years of age

not all does have yet come into kid production. The females which are the most thrifty and forward in development are usually the ones which

Table 10. Effect of Pregnancy and Lactation on Weight of Scoured Mohair

Sterile				Fertile			
Ages years		Number of Animals	Average, pounds	Ages years		Number of Animals	Average, pounds
At Kidding Season	At Shearing Season			At Kidding Season	At Shearing Season		
Clean Fall Fleeces (preceding the kidding season concerned)							
2	1½	107	3.17	2	1½	95	3.55
3	2½	42	3.33	3	2½	134	3.39
4	3½	17	3.08	4	3½	77	3.28
5	4½	8	3.32	5	4½	66	3.21
6	5½	9	3.10	6	5½	43	3.20
7	6½	3	2.68	7	6½	41	2.89
8	7½	6	2.56	8	7½	21	2.37
9	8½	7	2.18	9	8½	35	2.21
10	9½	9	2.04	10	9½	18	1.92
11	10½	2	3.72	11	10½	6	1.52
12	11½	.....	.....	12	11½	.....	.....
Clean Spring Fleeces							
2	2	164	2.75	2	2	148	2.58
3	3	61	3.12	3	3	181	2.78
4	4	37	2.95	4	4	136	2.84
5	5	17	2.98	5	5	108	2.74
6	6	17	2.51	6	6	80	2.59
7	7	10	2.44	7	7	64	2.40
8	8	13	2.36	8	8	54	2.17
9	9	8	2.38	9	9	35	1.82
10	10	10	1.94	10	10	31	1.72
11	11	6	1.96	11	11	14	1.25
12	12	2	1.92	12	12	3	1.74
Clean Fall Fleeces (succeeding the kidding season concerned)							
2	2½	96	3.66	2	2½	85	3.04
3	3½	22	3.64	3	3½	74	3.13
4	4½	10	3.64	4	4½	64	3.16
5	5½	8	3.80	5	5½	44	3.07
6	6½	9	3.17	6	6½	36	2.77
7	7½	2	1.40	7	7½	25	2.49
8	8½	8	2.48	8	8½	34	2.14
9	9½	5	2.02	9	9½	22	1.95
10	10½	2	1.74	10	10½	6	2.18
11	11½	.....	.....	11	11½	.....	.....
12	12½	.....	.....	12	12½	.....	.....

produce young at these earlier ages. This accounts for the significantly higher mohair production at the fall seasons preceding the first two kidding ages by the fertile animals. This also shows that the percentage differences discussed above do not measure all of the effect of pregnancy. In order to get a strictly accurate picture of the total effect of pregnancy, the females should have been divided before the breeding season and one group withheld from breeding. However, our data show beyond doubt that pregnancy has a very marked effect on the production of mohair at the younger ages, and a small effect at the older ages.

It has been impossible to completely separate the effect of pregnancy from that of the initial stages of lactation in the above discussion. On the other hand the difference in fleece weight between the sterile and fertile groups at the fall succeeding production should be entirely due to the effect of lactation. These are shown for both unscoured and

clean mohair in Tables 8 and 9. Study of these averages shows that the sterile group produced more unscoured mohair at every age except one, at which only three animals were involved. Study of the differences in unscoured mohair averages between sterile and fertile, sterile and raised, and raised and dry groups in relation to their probable errors, shows that all differences are significant at ages up to and including seven years. (7½ at shearing). The sterile group also averages more clean mohair than the fertile group at each age except two, at which ages there were only two animals in the sterile group. Weighted age converted averages to 100 have been computed and are shown in Table 11. These show that the sterile group averaged 19.35 per cent more unscoured mohair and 13.40 per cent more clean mohair than was produced by the fertile group.

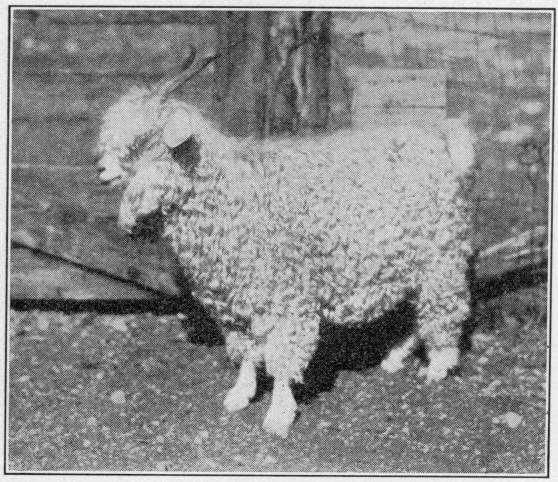

Fig. 10. A breeding female of the Station flock with good covering of head and neck.

The animal weights of the does in April have been averaged according to whether the animal was sterile or not. These are shown in Table 12. Study of these averages shows that the fertile group averages heavier than the sterile at the first two ages and at 8 and 12 years. When the differences are studied in relation to their probable errors, it is found that only at the first age, 2 years, is the difference statistically significant. This is in line with the observations that the animals that are

Table 11. Relative Weights of Fleeces of Female Angora Goats Grouped as Sterile or Fertile on Age Equivalent Base as 100

Shearing season relative to kidding season concerned	Fleeces	Animals		% Difference
		Sterile	Fertile	
Preceding Fall	Unscoured	96.56	101.79	—5.14
	Clean	97.61	101.07	—3.42
Spring	Unscoured	110.16	97.59	+12.82
	Clean	105.31	97.88	+7.43
Suceeding Fall	Unscoured	113.01	94.69	+19.35
	Clean	109.15	96.25	+13.40

Table 12. Effect of Pregnancy (Principally) on Spring Weight of Animal in Pounds

Ages years	Sterile goats		Goats which kidded but kids died		Goats which raised kids		All Fertile goats		All dry goats	
	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages
2	225	54.88	19	61.05	201	60.44	220	60.50	244	55.36
3	102	63.37	16	68.88	242	64.97	258	65.21	118	64.12
4	63	71.16	6	76.67	227	69.97	233	70.14	69	71.64
5	32	77.53	9	77.11	173	73.03	182	73.23	41	77.44
6	26	79.15	8	75.50	127	75.02	135	75.04	34	78.29
7	18	79.61	4	79.00	106	76.32	110	76.42	22	79.50
8	19	78.79	6	78.50	82	78.85	88	78.83	25	78.72
9	15	82.27	8	77.25	61	75.93	69	76.09	23	80.52
10	12	78.42	6	67.83	44	74.27	50	73.50	18	74.89
11	11	75.18	3	59.67	28	72.68	31	71.42	14	71.86
12	7	72.00	3	73.67	10	72.50	13	72.77	10	72.50
Relative average converted to 100		98.85		102.53		100.57		100.69		99.37
Relative average converted to 100 (ages 3-12 inclusive)		101.45		101.57		99.76		99.87		101.47

more forward in their development are the ones which raise young the first year in the breeding flock. Weighted age converted averages of all ages show that the sterile group weighed 1.83% less than the fertile group. However, if we exclude the average at 2 years and use all the rest, the sterile group averaged 1.58 per cent more than the fertile group. At two years of age the sterile group averages 9.29 per cent less than the fertile. We conclude that pregnancy has little direct effect on animal weight.

Staple length averages at the spring shearing for the does averaged according to whether the animal was sterile are not are shown in Table 13. This shows that with one exception the averages at the different ages are larger for the sterile group than for the fertile. The number of individuals in the sterile group at this age, 10 years, is only 15. The differences at the various ages have been studied in relation to their probable errors. The differences between the sterile and fertile, sterile and raised, and the dry and raised groups were clearly significant at ages 2 to 5 years inclusive. None of the differences at the older ages were highly significant, only one, at 8 years, showing probable significance. The numbers at the older ages become too small for this kind of comparison.

Conversion factors to base 100 have been prepared for staple length from Table 4. These have been used to compute weighted age converted averages for the sterile and fertile groups. The same have also been used separately to get the weighted age converted averages for all at five years and younger and for all over five years. These are shown in Table 13. When all ages are considered, the sterile group showed an average staple length 4.81 per cent greater than that of the fertile group. When the records are divided as indicated above, we find that the younger ages contribute more of this difference than do the older ages. The

mohair produced by the sterile group averaged 5.71 per cent longer at the younger ages than did the fertile group. At the older ages the sterile group averaged only 3.85 per cent greater. Undoubtedly, preg-

Fig. 11. Part of the flock during the kidding season, showing sheared does and their kids, also the boxes used for protection of the kids while their mothers are out on the range.

Table 13. Effect of Pregnancy (Principally) on Spring Length of Staple in Inches

Ages years	Sterile goats		Goats which kidded but the kids died		Goats which raised kids		All fertile goats		All dry goats	
	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages
2	231	5.57	15	5.49	198	5.22	213	5.24	246	5.56
3	103	5.78	16	5.65	239	5.45	255	5.46	119	5.76
4	63	5.95	6	5.50	228	5.59	234	5.59	69	5.91
5	32	6.22	10	5.91	169	5.76	179	5.77	42	6.15
6	27	5.84	7	5.53	135	5.77	142	5.75	34	5.78
7	18	6.10	4	5.60	109	5.66	113	5.66	22	6.01
8	19	5.78	6	5.48	90	5.65	96	5.64	25	5.71
9	15	5.66	9	5.44	62	5.36	71	5.37	24	5.58
10	15	5.17	8	5.48	47	5.51	55	5.51	23	5.28
11	11	5.54	3	5.17	29	5.24	32	5.24	14	5.46
12	8	5.35	3	4.47	11	5.29	14	5.11	11	5.11
Relative average converted to 100		103.24		99.12		98.39		98.43		102.64
Relative average converted to 100 (2-5 yrs. inc.)		103.61		100.77		97.84		98.01		103.27
Relative average converted to 100 (6-12 yrs. inc.)		101.86		97.17		99.34		99.15		100.67

nancy has the greatest effect on staple length at the younger ages, but it is effective to a lesser extent as the animals get older.

The average diameter of fiber at shoulder has been studied for the sterile and fertile groups to determine the effect of pregnancy on fineness of fiber. These are shown in Table 14. From this it is seen that at ages 2 to 8 inclusive the averages for the fertile are greater than for the sterile does. At 9 to 12 years inclusive the sterile does average greater. The averages at the first two years (2 and 3) are the only ones at which the differences between sterile and fertile, sterile and raised, and dry and raised are significant statistically. Conversion factors to 100 were computed from Table 3 and used to get weighted age converted averages for each group. These averages are shown in Table 14. This shows that the shoulder mohair from the fertile does averages 3.83 per cent greater than that from the sterile group. When we consider the two youngest ages (2 and 3 years), we find that of the fertile

Table 14. Effect of Pregnancy on Spring Diameter of Fiber (Shoulder) in Ten-thousandths of an Inch

Ages years	Sterile goats		Goats which kidded but the kids died		Goats which raised kids		All fertile goats		All dry goats	
	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages	No. Animals	Averages
2	219	10.24	15	11.29	183	11.11	198	11.13	234	10.31
3	89	11.25	14	11.59	218	11.84	232	11.83	103	11.12
4	45	11.94	6	12.30	199	12.03	205	12.04	51	11.99
5	25	12.22	10	12.05	149	12.48	159	12.45	35	12.17
6	22	12.46	7	12.51	114	12.76	121	12.75	29	12.47
7	15	12.98	3	12.63	96	13.34	99	13.32	18	12.92
8	14	13.45	6	13.00	83	13.49	89	13.46	20	13.32
9	15	13.66	9	14.33	62	13.12	71	13.27	24	13.91
10	16	12.92	8	13.11	47	12.83	55	12.87	24	12.98
11	13	13.96	3	12.13	29	13.72	32	13.57	16	13.68
12	8	14.06	3	13.97	11	12.75	14	13.01	11	14.04
Relative average converted to 100		97.42		101.50		101.26		101.30		98.03
Relative average converted to 100 (2 and 3 years)		95.80		102.97		103.00		103.05		96.43
Relative average converted to 100 (4-12 yrs. incl.)		100.29		100.72		100.38		100.41		100.40

group 7.04 per cent greater than that of the sterile group. The age converted averages of the groups at 4 to 12 years of age inclusive are practically the same. This shows that the differences which are significant are related to the general development of the animal rather than to age as such, or to the direct effect of pregnancy.

Discussion of Quantity of Mohair as Related to Growth of Animal

The data on fleece weights, diameter of fiber, length of staple, and animal weight reveal the fact that for only two of these, animal weight and diameter of fiber, are the maximum reached at the same age. Considering females only, it is found that the maximum average fleece

weight (both unscoured and clean) is reached at three years of age, while animal weight and diameter of fiber reach their maximum averages at eight years of age. Staple length is greatest at the first year of age. These relationships are shown in Figure 3.

The animal might be considered mature when it has reached its maximum weight. This however, is long past the period of maximum production of mohair, which has already declined twenty-five per cent

Table 15. Factors for Converting Unscoured Fleece Weights to an Equivalent Base of 100

Age years	All Females	Females sterile	Females fertile	Males
1 Fall	51.55	.....	.....	46.30
1 Spring	35.71	.....	.....	32.79
2 Fall	26.32	.....	.....	21.05
2 Spring	32.05	29.67	33.00	23.64
3 Fall	26.11	23.81	28.90	18.08
3 Spring	29.15	26.11	30.30	19.92
4 Fall	26.39	23.04	28.90	15.80
4 Spring	29.33	26.88	29.33	18.52
5 Fall	27.55	23.81	28.82	16.69
5 Spring	30.03	26.18	30.30	18.66
6 Fall	29.41	25.45	30.12	16.61
6 Spring	32.36	30.96	32.36	18.94
7 Fall	31.55	27.55	32.05	17.12
7 Spring	35.46	32.79	35.71	22.57
8 Fall	35.21	28.41	36.23	18.62
8 Spring	40.00	37.31	40.98	28.74
9 Fall	38.61	34.48	39.53	25.97
9 Spring	44.84	38.76	47.85	33.90
10 Fall	42.55	40.00	43.48	27.25
10 Spring	46.51	39.53	50.00	30.03
11 Fall	48.54	36.23	52.08	.....
11 Spring	50.51	40.32	55.56	.....
12 Fall	52.63	41.32	62.89	.....
12 Spring	54.95	44.05	62.50	.....
13 Fall	58.82	66.67	60.61	.....
13 Spring	61.35	.....	.....	.....

from the maximum. We have not been able to use an adequate measure of density of fleece, or number of fibers per unit area. A decline in actual density is probably the reason for the anomolous situation in which the animals are increasing in size, and the diameter of fiber is increasing, while the weight of mohair is decreasing. Only relatively slight change in average staple length takes place during this period.

It is interesting to study the average pounds of mohair produced per pound of body weight at the various ages. This has been done for the females and the data are shown in Table 20 and graphically in Figure 4. These show that the maximum quantity per pound body weight is produced at two years of age, after which there is a rapid decline. The pounds mohair per pound body weight might be called the efficiency of

Table 16. Factors for Converting Clean Fleece Weights to an Equivalent Base of 100

Age years	All Females	Females Sterile	Females Fertile	Males
1 Fall	59.52	.....	.....	54.05
1 Spring	42.92	.....	.....	36.90
2 Fall	29.85	.....	.....	23.31
2 Spring	37.45	36.36	38.76	27.03
3 Fall	29.67	27.32	32.89	20.08
3 Spring	34.84	32.05	35.97	22.62
4 Fall	30.86	27.47	31.95	17.83
4 Spring	34.97	33.90	35.21	20.08
5 Fall	31.06	27.47	31.65	19.53
5 Spring	36.10	33.56	36.50	20.53
6 Fall	31.45	26.32	32.57	20.41
6 Spring	38.91	39.84	38.61	21.51
7 Fall	35.09	31.55	36.10	21.10
7 Spring	41.67	40.98	41.67	27.03
8 Fall	41.49	71.43	40.16	22.62
8 Spring	45.25	42.37	46.08	31.15
9 Fall	45.25	40.32	46.73	.....
9 Spring	51.81	42.02	54.95	53.19
10 Fall	51.02	49.50	51.28	50.00
10 Spring	56.50	51.55	58.14	.....
11 Fall	48.08	57.47	45.87	.....
11 Spring	68.49	51.02	80.00	.....
12 Fall	.....	.....	.....	.....
12 Spring	55.25	52.08	57.47	.....

Table 17. Factors for Converting Spring Staple Length to an Equivalent Base of 100

Age	All Females	Females Sterile	Females Fertile	Males
6 months	16.10	.....	.....	16.84
1 year	16.67	.....	.....	16.31
2 years	18.45	17.95	19.08	18.59
3 years	17.95	17.30	18.32	17.89
4 years	17.64	16.81	17.89	17.79
5 years	17.12	16.08	17.33	16.78
6 years	17.33	17.12	17.39	16.67
7 years	17.45	16.39	17.67	16.72
8 years	17.51	17.30	17.73	16.13
9 years	18.38	17.67	18.62	17.09
10 years	18.32	19.34	18.15	18.52
11 years	18.69	18.05	19.08	.....
12 years	19.12	18.69	19.57	.....
13 years	19.34	.....	.....	.....

the animal in growing mohair. Using the term in this limited sense, it is evident that after four years of age the animals are less than 80 per cent as efficient as they were at the maximum. This also emphasizes the importance of the first year mohair production. While this is fifteen

Table 18. Factors for Converting Animal Weight to an Equivalent Base of 100

Age	Females	Males
6 months	2.95	2.67
1 year	2.15	1.65
2 years	1.74	1.24
3 years	1.54	1.00
4 years	1.43	.82
5 years	1.37	.72
6 years	1.32	.67
7 years	1.31	.67
8 years	1.27	.72
9 years	1.29	.74
10 years	1.34	.92
11 years	1.38	.....
12 years	1.37	.....
13 years	1.34	.....

Table 19. Factors for Converting Diameter of Fiber to an Equivalent Base of 100

Age	Shoulder		Side		Thigh		Average	
	Females	Males	Females	Males	Females	Males	Females	Males
6 months	12.80	12.42	12.69	12.58	12.42	12.39	12.64	12.45
1 year	11.03	10.59	11.35	11.20	11.30	10.92	11.22	10.91
2 years	9.38	9.16	9.54	9.58	9.54	9.47	9.49	9.40
3 years	8.61	7.42	8.67	7.82	8.80	7.76	8.69	7.66
4 years	8.32	6.55	8.35	6.81	8.56	7.13	8.41	6.82
5 years	8.05	6.44	8.07	6.61	8.37	6.97	8.16	6.67
6 years	7.87	6.07	7.87	6.26	8.06	6.62	7.94	6.31
7 years	7.54	5.64	7.54	5.84	8.01	6.28	7.69	5.91
8 years	7.43	5.66	7.49	5.84	7.77	6.59	7.56	6.00
9 years	7.67	6.39	7.82	6.42	8.12	6.33	7.87	6.38
10 years	7.84	6.08	7.72	6.39	8.03	6.49	7.86	6.32
11 years	7.41	.....	7.58	.....	7.97	.....	7.65	.....
12 years	7.62	.....	7.57	.....	7.89	.....	7.69	.....
13 years	8.26	.....	8.30	.....	9.52	.....	8.66	.....

per cent less efficient than that of the following year, there is usually a much wider spread between the price of grown and kid hair. For example, if kid mohair were selling at 40 cents per pound, it would be necessary for the mohair from two-year-old does to sell for 34 cents per pound to yield the same income per pound body weight. Also, at all ages after three years, it would be necessary for the mohair to sell for

Table 20. Relation of Weight of Mohair Per Pound Body Weight to Age of Angora Females

Age Years	Pounds Fleece per Pound Body Weight		Percentage of production at 2 Years of age	
	Unscoured	Clean	Unscoured	Clean
1	.102	.086	85.1	81.9
2	.120	.105	100.0	100.0
3	.112	.095	93.3	90.5
4	.103	.087	85.8	82.9
5	.095	.080	79.2	76.2
6	.086	.076	71.7	72.4
7	.078	.069	65.0	65.7
8	.068	.059	56.7	56.2
9	.062	.053	51.7	50.5
10	.060	.050	50.0	47.6
11	.056	.049	46.7	46.7
12	.051	.....	42.5	.....
13	.045	.....	37.5	.....

more per pound than kid mohair to yield as much income per pound body weight. These figures add emphasis to the economic position of the Angora goat during its first year of life.

According to Hayes (6), "in 1870 a manufacturing establishment in this country using considerable mohair issued a circular advising all breeders to kill their goats after they reached six years, that thus a more even and uniform quality of mohair might be produced."

Factors for Converting Records to the Same Relative Basis

When we use the records of special groups, such as the progeny of particular sires, we find that we may have both sexes represented, that they may represent different ages, and that the females may have been either sterile or fertile during the time represented by the records. Accordingly, it is necessary either to compare only groups of the same sex, age, and fertility, or to adjust the records to a comparable basis. The use of comparable groups only (without adjustment) greatly limits the number of records in any comparison. Adjusting the records to a comparable basis is done by increasing the record of a young animal to that which

it is reasonable to expect it would have been had the animal been mature. For example, the unscoured mohair produced by a female at the first fall shearing was in our studies on the average 1.94 pounds, while at the third fall shearing it reached the maximum average of 3.84 pounds. Thus the maximum production was 97.9 per cent greater than that produced the first fall. We could take this figure, 97.9 per cent, of a first fall record and add it to the record and this would be the three-year-old fall fleece equivalent. The same result is obtained by dividing 3.84 by 1.94, which gives 1.979, and using this as a conversion factor. Then the particular record would be multiplied by 1.979 to get the third fall equivalent for this particular record. This procedure can be used to convert all records to the same age and sex basis. This is essentially the procedure which has long been in use with dairy cattle production records. However, we find it more convenient to use an arbitrary value such as 100 to represent the group average. Accordingly, 100 is divided by each average to get the corresponding conversion factor. Then when any record is multiplied by the conversion factor corresponding to the age, sex, and fertility of animal concerned, if the resulting figure is 100, it indicates that the record was average. The amount above or below 100 represents the percentage above or below the average found in this study for the group.

Using this method, we have prepared conversion factors for mohair production based on the eleven year averages discussed earlier in this paper. They are for unscoured fleece weight, clean fleece weight, staple length, animal weight, and diameter of fiber, and are given in tables 15 to 19 inclusive. In table 15 the conversion factors for fall and spring weights of all males and all females were computed from the corresponding parts of 12 months mohair weight (same animals) instead of from the actual averages of fall and spring weights. The other tables were figured directly from the averages for the respective groups concerned. These may be considered fairly representative for registered Angora goats raised under range conditions in the Edwards Plateau region of Texas. As such they should be useful for practical comparisons within stud flocks as well as for further experimental work.

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Summary and Conclusions

1. Age of animal was found to have a very marked influence on both unscoured and clean fleece weights, the average weights increasing up to three years of age after which they became steadily less.

2. Age of animal also has a very marked relation to diameter of mohair fiber and to body weight. Both increase to eight years of age.

3. Length of staple, amount of kemp, and belly covering were also influenced by the age of the animal but to a much less marked degree. Length of staple is greatest at the youngest ages, kemp increases with age, and belly covering tends to become lighter with old age.

4. Angora bucks produced 18 per cent heavier fleeces, unscoured basis, and approximately 29 per cent heavier, clean basis, than those produced by the females. The bucks also weighed 22.7 per cent heavier and produced fleeces that averaged 4.12 per cent coarser in diameter measurement than did the females. The staple length also averaged slightly less for bucks than for females.

5. The diameter of fiber averages at shoulder and side were very close, that grown on the shoulder being slightly greater at most ages after removal of the first fall fleece. The diameter of fiber at the thigh averaged greater than either shoulder or side samples for the first fall fleece only.

6. Pregnancy was found to have a marked effect on mohair weights, the unscoured fleeces of the sterile group averaging 12.92 per cent more than those of the fertile group. Clean or scoured fleeces averaged 7.43 per cent heavier for the sterile than for the fertile females. The succeeding fall fleeces produced during the suckling period averaged greater for the sterile group, being 19.35 per cent heavier, unscoured basis, and 13.4 per cent heavier, clean, than for the fertile group.

7. While pregnancy and lactation may have had some influence on reducing body weight at the younger ages, this was apparently offset by a certain amount of automatic selection, as the larger females with more advanced development were the ones which were fertile at the earlier ages. This was shown by the weights at 2 and 3 years of age.

8. Staple length was 4.81 per cent greater for the sterile than for the fertile group. The younger ages, up to 5 years, contribute more of this difference than do the older ages. At only 2 and 3 years of age was there a significant difference in average diameter of fiber for the sterile and fertile groups, and in these the fertile averaged coarser fiber than did the sterile. This is probably related to the general body development of the animal, rather than the effect of pregnancy and lactation.

9. The maximum for fleece weight was reached at three years of age, while maximum body weight and diameter of mohair fiber were not reached until the animals were 8 years of age. Staple length was at its maximum the first year.

The combination of time relationships produces a curve of mohair production per pound body weight with its maximum at 2 years of age, and reveals the economy of production at the earlier ages. This, considered with the better quality of the mohair produced during the first year, emphasizes the importance of this part of the life of the Angora goat.

10. Conversion factors have been prepared for use when it is desired to group together records of animals of different age, sex, and fertility.

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